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Telemedicine Across Clinical Settings: A Systematic Review of Effectiveness, Equity, and Quality of Care

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KEYWORDS

telemedicine, virtual care, digital health equity, diagnostic quality, patient safety, chronic disease, mental health.

ABSTRACT:

In healthcare we have witnessed a huge increase of telemedicine use among primary and specialty care, chronic illness management, and mental health services. Despite its broad acceptance, there remains uncertainty regarding the relative clinical efficacy, its effect on quality and safety, and whether it reduces or exacerbates health disparities. To synthesize evidence on telemedicine across clinical settings, focusing on clinical effectiveness, equity impacts, and quality of care. Including diagnostic performance and patient safety. We conducted a systematic review of our findings, using PubMed, Scopus, Web of Science as well as the Cochrane Library following the PRISMA 2020 standards. A systematic review was conducted following PRISMA 2020 guidelines. Peer-reviewed systematic reviews, meta-analyses, randomized trials, and high-quality observational studies evaluating synchronous and asynchronous telemedicine were included. Outcomes were categorized into effectiveness, equity, and quality domains. A narrative synthesis was conducted, and meta-analytic effect sizes were summarised when available. Twenty-two studies met the inclusion criteria. Telemedicine demonstrated clinical outcomes comparable to in-person care for many

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low-to-moderate complexity encounters, particularly in primary care and mental health, with consistent advantages in timeliness and convenience. Benefits were seen in chronic disease management and mental health, with modest improvements in intermediate outcomes. Equity findings were mixed: telemedicine improved access for patients with mobility or transportation barriers but risked widening disparities due to digital determinants. Quality evidence indicated acceptable diagnostic performance for selected presentations when structured triage and escalation pathways were used. However, the measurement of standardized safety outcomes was limited. Telemedicine can deliver effective care across multiple clinical settings, particularly within hybrid models that align modality with clinical risk and patient preference. Achieving equitable, high-quality virtual care requires robust safety governance and equity-by-design strategies. Future research should prioritize developing standardized safety outcomes, such as diagnostic accuracy and adverse event tracking, and conduct rigorous equity analyses focusing on digital access and demographic disparities.

INTRODUCTION

Telemedicine the remote delivery of clinical services using digital communication technologies has evolved from a supplementary option into a core component of modern healthcare delivery. Its rapid expansion has been driven by shifting patient expectations, workforce shortages, and the need to maintain continuity of care during disruptions to in-person services, including pandemics [1,2]. Telemedicine now encompasses a wide range of modalities, including synchronous video and telephone consultations, asynchronous messaging and store-and-forward systems, and hybrid models that integrate virtual and in-person encounters. These modalities differ in their clinical capabilities, information exchange, and workflow requirements, making it essential to evaluate telemedicine not as a single intervention but as a diverse set of delivery pathways.

Global health authorities emphasize that digital health interventions must be assessed not only for clinical effectiveness but also for feasibility, acceptability, and equity. The World Health Organization highlights that digital tools can expand access while simultaneously excluding populations with limited digital resources, underscoring the need for equity-sensitive implementation [3,4]. Similarly, the Agency for Healthcare Research and Quality (AHRQ) note persistent uncertainty regarding optimal use cases, long-term outcomes, and the conditions under which telemedicine adds value or introduces risk [5]. As a result, the telemedicine literature has shifted from asking whether telemedicine "works" to examining for whom, under what circumstances, and with what safeguards it is most effective.

Evidence across clinical settings suggests that telemedicine offers particular strengths in timeliness, convenience, and continuity of care. Studies in chronic disease management show that remote monitoring and structured virtual follow-up can support medication titration, self-management, and early intervention, sometimes yielding modest improvements in intermediate outcomes [6–8]. Mental health services have demonstrated especially strong comparability between virtual and in-person care, given the conversational nature of psychotherapy and the substantial access barriers faced by many patients [9–11]. However, effectiveness varies by condition, modality, and integration with in-person services, with more mixed results for presentations requiring detailed physical examination or complex diagnostic workups.

Quality and safety remain critical considerations. Telemedicine alters the clinical encounter in ways that may influence diagnostic accuracy, escalation decisions, and follow-up processes. While some studies report acceptable diagnostic performance for selected primary care presentations when structured assessment tools and escalation pathways are used, standardized measurement of patient safety outcomes remains limited and heterogeneous across studies [12]. Without robust safety governance, health systems may overestimate telemedicine's safety or fail to detect telemedicine-specific risks.

Equity is a third essential dimension. Telemedicine can reduce access barriers for patients with transportation challenges, mobility limitations, caregiving responsibilities, or inflexible work schedules. However, its benefits are unevenly distributed due to digital determinants of health, including broadband availability,

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device access, digital literacy, language support, disability accommodations, and privacy constraints. Evidence consistently shows differential uptake and outcomes across sociodemographic groups, raising concerns that telemedicine expansion may widen existing health disparities unless equity-by-design strategies are implemented [13].

Given these complexities, a cross-setting synthesis that integrates effectiveness, equity, and quality is urgently needed. Many existing reviews are condition-specific or modality-specific and do not fully examine how these domains interact. Yet real-world telemedicine decisions require balancing clinical appropriateness, patient preference, digital access, and safety considerations. A narrative synthesis approach was selected due to heterogeneity in telemedicine modalities, clinical settings, and outcome definitions. This review aims to determine whether telemedicine provides non-inferior or superior clinical effectiveness compared with in-person or usual care across primary care, specialty care, chronic disease management, and mental health. It further evaluates telemedicine's impact on quality of care, including timeliness, continuity, patient experience, diagnostic quality, and safety, while assessing equity implications related to differential access, uptake, and outcomes. Additional objectives include identifying implementation determinants for safe, equitable delivery and highlighting evidence gaps to guide future research.

METHODOLOGY

Study design

This was a systematic review conducted and reported as described by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. A narrative synthesis approach was applied because considerable heterogeneity was predicted across telemedicine modalities, clinical settings, populations, comparators, and outcome definitions.

Review question

Evaluation of the effectiveness, equity and quality of telemedicine in clinical practice was the aim of this review.

The PICOS framework guided the development of the review question:

- Population: patients who receive care in primary care, specialty care, chronic disease management, or mental health settings.
- Intervention modalities: telemedicine interventions: synchronous video consultations, telephone consultations, asynchronous messaging, store-and-forward systems, remote monitoring, and hybrid care models.
- Comparison: in-person care, usual care, or alternative telemedicine modalities.
- Outcomes: clinical effectiveness, equity-related outcomes, quality of care, patient experience, diagnostic quality, and patient safety.

The designs of study systematic reviews, meta-analyses, randomized controlled trials and high-quality observational studies.

Eligibility criteria

Studies were included if they: considered telemedicine as an intervention in clinical care; reported effectiveness, equity, quality of care, diagnostic performance, or patient safety; involved a comparator group including in-person care, usual care, or other types of telemedicine; were reported in peer-reviewed journals; and were written in English.

Studies were excluded if they: were not focused on telemedicine or virtual clinical care; did not include relevant outcome measures; did not have a comparator when one was necessary to make sense of effectiveness or quality outcomes; were editorials, commentaries, protocols, conference abstracts, or non-peer-reviewed reports; or involved non-clinical digital initiatives with little or no clinical relevance to care delivery.

Search strategy and information sources

The electronic literature search was performed on:

• PubMed/MEDLINE

• Embase

• CINAHL

• Scopus

• Cochrane Library

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The search took place from database inception to 31 December 2025, culminating with an in-depth online search on 31 December 2025. The search terms used were controlled vocabulary and free-text terms related to telemedicine, virtual care, remote consultation, digital health equity, diagnostic quality, patient safety, and treatment outcomes. Wherever possible, Boolean operators, truncation, and database-specific indexing terms were used. Supplementary File 1 presents the complete electronic search strategies for all databases. Finally, reference lists of included studies and related review articles were curated manually in order to identify further eligible studies.

Study selection

All records extracted were imported to a reference management system and duplicates were removed. Two reviewers independently screened titles and abstracts for potential eligibility. Once selected, full texts of potentially relevant studies were independently evaluated using the inclusion and exclusion criteria. Controversies were resolved by discussion and if required with the inclusion of third reviewer consultation. The PRISMA 2020 flow diagram and the study selection process were documented.

Data extraction

We standardized the data extraction form to be developed and piloted before using it. The following data was extracted from each included study:

- Author(s) and year of publication
- Country and clinical setting
- Study design
- Telemedicine modality used
- Population characteristics
- Comparator (if applicable)
- Reported outcomes
- Key findings
- Implementation aspects (e.g., triage and escalation pathways)
- Limitations highlighted by the study authors

Data extraction was done independently by two reviewers and differences were settled by discussion and consensus.

Quality appraisal

Methodological rigorousness was assessed by appraisal tools specific to the design:

- AMSTAR 2 for assessing the quality of systematic reviews and meta-analyses
- RoB 2 for evaluating risk of bias in randomized controlled trials
- ROBINS-I for assessing risk of bias in observational studies

Quality assessment was used to facilitate interpretation and confidence in the evidence, while no papers were excluded solely by relying on the quality rating alone.

Data synthesis

Since interventions involved diverse populations and outcome reporting, narrative synthesis was executed rather than a pooled meta-analysis. Information was integrated as follows: clinical settings: primary care, specialty care, chronic disease management, and mental health; outcomes: effectiveness, equity and quality/safety; and telemedicine modality: synchronous, asynchronous, and hybrid models. Where meta-analytic estimates were reported within included reviews, they describe the direction of effect qualitatively as improvement, no significant difference, or worse outcome compared with comparator care.

Assessment of publication bias and evidence considerations

An independent formal quantitative review of publication bias was not undertaken because all included studies were of heterogeneous design, interventions, and outcome measures and no pooled meta-analysis was performed. Yet there was some consideration of potential reporting bias in interpreting data in particular focus on positive telemedicine outcomes, inconsistent reporting of safety events, and limited equity-stratified analyses.

Ethical considerations

This was a systematic review of published literature, and did not require either personal contact with human subjects or the use of identifiable personal data. Therefore, ethical approval and informed consent did not need to be obtained.

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RESULTS

A total of 1,284 records were identified through database searching. After removing duplicates, 1,102 records underwent title and abstract screening. Seventy-four full-text articles were assessed for eligibility, of which 52 were excluded for reasons including wrong outcomes (n = 21), non-telemedicine focus (n = 14), absence of a comparator (n = 9), or lack of peer review (n = 8). Ultimately, 22 studies met the inclusion criteria and were synthesized. The characteristics of the included studies are summarized in Figure 1. Telemedicine modalities included synchronous video and telephone visits, asynchronous secure messaging, store-and-forward systems, and hybrid models integrating virtual and in-person care.

Figure 1: PRISMA 2020 flow Diagram of Study Selection

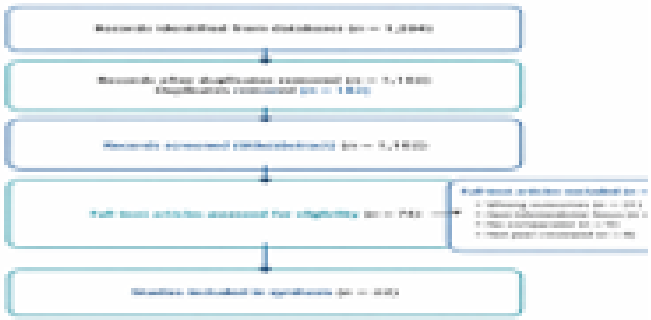
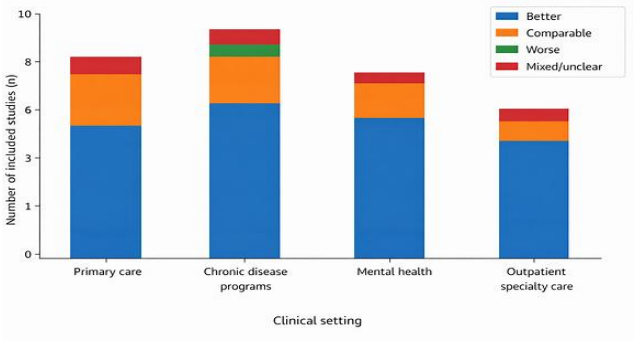


Figure 2. Effectiveness Outcomes by Clinical Setting



Telemedicine demonstrated clinical effectiveness comparable to in-person care for many low-to-moderate-complexity encounters. In primary care, studies consistently reported similar outcomes for follow-up visits, medication management, and review of test results. Telemedicine was particularly effective when clinical needs relied primarily on history-taking and shared decision-making rather than detailed physical examination. Some studies noted reduced no-show rates and improved appointment adherence, suggesting enhanced accessibility and convenience.

In outpatient specialty care, effectiveness varied by condition and the extent to which physical examination was required. Telemedicine performed well for dermatology, mental health, endocrinology, and routine postoperative follow-up, whereas evidence was mixed for specialities requiring hands-on assessment. Hybrid models where telemedicine is used for triage, monitoring, or counselling achieved outcomes comparable to traditional care while reducing unnecessary in-person visits.

Chronic disease management shows significant benefits. Studies evaluating hypertension, diabetes, and heart failure reported modest improvements in intermediate outcomes such as systolic blood pressure and self-management behaviours when telemedicine was combined with structured remote monitoring and protocol-driven care. However, hospitalization rates and long-term disease control outcomes were generally comparable rather than superior to usual care.

Mental health care demonstrates consistent equivalence between telemedicine-delivered psychotherapy and in-person treatment for common conditions like depression and anxiety. Several studies reported high patient satisfaction, improved continuity, and reduced barriers to accessing behavioral health services. Telemedicine was particularly effective for routine follow-up and counselling, although privacy constraints and crisis management limitations were noted.

A visual summary of effectiveness outcomes across clinical settings is presented in Figure 2, and detailed effectiveness patterns are shown in Table 1.

Table 1: Summary of Telemedicine Effectiveness Across Clinical Settings

Clinical Setting	Better	Comparable	Worse	Mixed/ Unclear	Insufficient Safety/Equivalence

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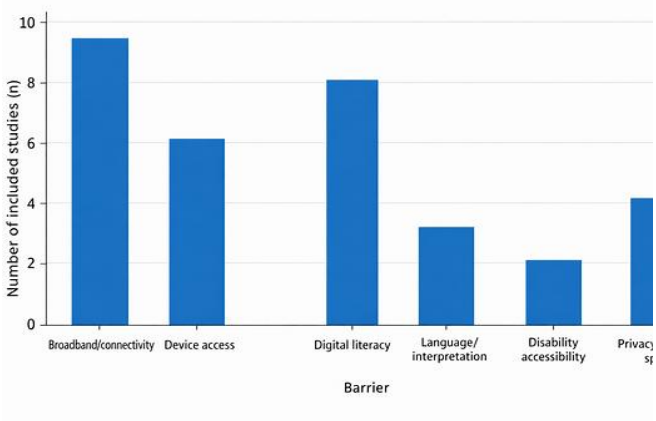
Primary care	2	5	0	2	3
Chronic disease programs	4	5	1	2	4
Mental health	4	3	0	1	2
Outpatient specialty care	2	2	0	1	2

Figure 3. Frequency of Equity Barriers Reported



Equity Findings

Equity-related findings were mixed and highlighted the dual potential of telemedicine to reduce or exacerbate disparities. Many studies reported improved access for patients facing transportation challenges, mobility limitations, caregiving responsibilities, or geographic barriers. Telemedicine also facilitated more flexible scheduling and reduced time burdens for working adults.

However, digital determinants of health emerged as significant barriers. Limited broadband access, inadequate devices, low digital literacy, language barriers, and lack of disability accommodations were frequently cited as factors restricting telemedicine uptake among older adults, low-income populations, rural residents, and individuals with limited English proficiency. Several studies reported lower telemedicine utilization among these groups despite overall increases in virtual care availability. Privacy constraints such as lack of a quiet or confidential space at home were particularly relevant in mental health settings.

The frequency of equity barriers reported across studies is summarized in Table 2 and visualized in Discussion.

Table 2: Equity Barriers Reported Across Included Studies

Barrier	Studies Reporting Barrier
Broadband/connectivity	10
Device access	8
Digital literacy	9
Language/interpretation	6
Disability accessibility	5
Privacy / private space	7

Quality of Care, Diagnostic Performance, and Safety

Quality outcomes were most frequently assessed through patient experience, timeliness, and continuity. Telemedicine consistently improved timeliness by reducing wait times and enabling rapid follow-up. Patient satisfaction was generally high, with many patients valuing convenience and reduced travel.

Diagnostic quality and safety outcomes were less consistently reported. Studies that evaluated diagnostic accuracy found telemedicine acceptable for selected presentations when structured assessment tools, standardized questionnaires, and clear escalation pathways were used. However, evidence on adverse events, diagnostic delays, and escalation failures was limited and heterogeneous. Few studies employed standardized safety metrics, highlighting a major

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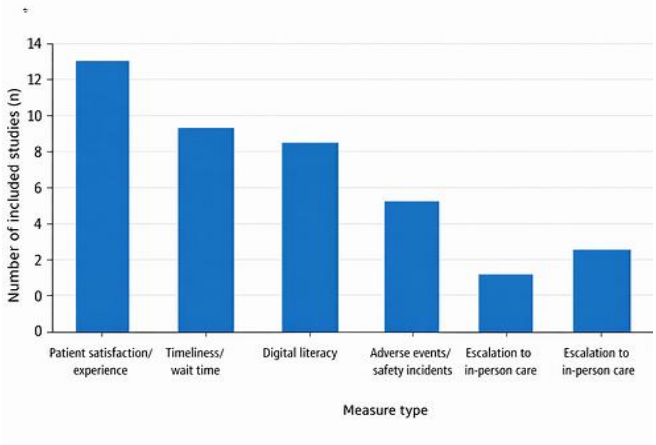
evidence gap. Quality and safety reporting frequencies are summarized in Table 3 and illustrated in Figure 3.

Table 3: Quality and Safety Measures Reported

Measure Type	Studies Reporting
Patient satisfaction/experience	14
Timeliness/wait time	11
Diagnostic quality/accuracy	5
Adverse events/safety incidents	3
Escalation to in-person care	6
Equity-stratified outcomes	7

Figure 4. Frequency of Quality/Safety Measures Reported



DISCUSSION

This systematic review synthesizes evidence from 22 studies evaluating telemedicine across primary care, specialty care, chronic disease management, and mental health services. Findings show that telemedicine delivers clinical outcomes comparable to in-person care for many low-to-moderate complexity encounters, with advantages in timeliness, convenience, and continuity. This aligns with prior evidence on telehealth's effectiveness for routine follow-up and chronic disease monitoring [9,10]. However, gaps persist in diagnostic safety measurement and equity concerns driven by digital determinants of health. Telemedicine's performance depends on clinical context, patient characteristics, and robust implementation structures.

Telemedicine performs well when clinical needs rely on history-taking, shared decision-making, and longitudinal monitoring. In primary care, it is effective for follow-up visits, medication management, and reviewing test results, consistent with previous reviews showing high patient satisfaction and comparable clinical outcomes for low-acuity conditions [11]. In specialty care, effectiveness varied by condition. Dermatology, mental health, endocrinology, and postoperative follow-up showed strong comparability, whereas specialties requiring hands-on assessment demonstrated more mixed results. These differences reinforce the importance of aligning telemedicine use with clinical appropriateness rather than applying it uniformly across all encounter types.

Chronic disease management showed some of the strongest signals of benefit. Studies on hypertension, diabetes, and heart failure report modest improvements in intermediate outcomes when telemedicine is combined with structured remote monitoring and protocol-driven care [12,13]. This suggests telemedicine's value lies in enabling more frequent touchpoints, earlier intervention, and enhanced patient engagement. However, long-term outcomes such as hospitalization rates and disease progression are comparable to usual care, indicating telemedicine should be viewed as a complementary tool.

Mental health care demonstrated consistent equivalence between telemedicine-delivered psychotherapy and in-person treatment for common conditions such as depression and anxiety. High patient satisfaction, improved continuity, and reduced access barriers are reported, consistent with prior systematic reviews [14,15]. This is particularly relevant given global shortages in mental health providers and logistical barriers faced by many patients. However, privacy constraints, limited access to confidential spaces, and crisis management challenges highlight the need for hybrid models and clear escalation pathways.

Equity findings reveal a dual narrative. Telemedicine improves access for patients with transportation challenges, mobility limitations, caregiving responsibilities, or geographic barriers. However, digital determinants of health create substantial disparities in telemedicine uptake and outcomes. These barriers have been widely documented in digital health equity

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literature, emphasizing the need for equity-by-design principles [16,17,18]. Older adults, low-income populations, rural residents, and individuals with limited English proficiency are underrepresented among telemedicine users. These findings underscore that telemedicine expansion alone does not guarantee equitable access; instead, targeted strategies such as multilingual platforms, low-bandwidth options, digital navigation support, and infrastructure investment are essential.

Quality and safety outcomes are the least consistently reported across studies. While patient satisfaction and timeliness are strong, diagnostic quality and safety outcomes are rarely measured using standardized methods. This gap mirrors concerns raised in prior telemedicine evaluations, noting that safety measurement frameworks may not capture telemedicine-specific risks [16]. Studies incorporating structured assessment tools and clear escalation pathways provide stronger reassurance regarding diagnostic safety, particularly for primary care presentations. However, the overall scarcity of safety data represents a significant evidence gap. Without systematic monitoring of telemedicine-specific risks, health systems may overestimate safety or fail to identify new failure modes unique to virtual care [19,20,21,22].

Taken together, these findings suggest telemedicine is most effective when integrated into hybrid care models aligning modality with clinical risk, patient preference, and digital access. Telemedicine should not be viewed as a universal substitute for in-person care but as a flexible component of a broader care ecosystem. To ensure safe, high-quality, and equitable implementation, health systems must invest in digital infrastructure, develop standardized safety metrics, and adopt equity-focused design principles consistent with WHO and AHRQ guidance [6,7,10,23,24,25].

Strength and Limitations

This review's strengths include its broad cross-setting scope and integration of effectiveness, equity, and quality domains, offering a comprehensive understanding of telemedicine performance. The use of PRISMA-guided methods and design-appropriate appraisal tools enhances rigor. However, heterogeneity across study designs, populations, and outcome measures limits quantitative synthesis. Diagnostic safety and equity outcomes are inconsistently reported, reducing comparability. Most evidence originates from high-income settings, limiting generalizability. Additionally, pandemic-era studies may not reflect stable telemedicine use patterns, and publication bias cannot be excluded.

CONCLUSION AND RECOMMENDATIONS

Across the 22 included studies, telemedicine is generally comparable to in-person care for many follow-up and low-to-moderate complexity encounters, with consistent advantages in timeliness and convenience. Benefits are most evident when telemedicine is integrated into structured chronic disease programs and mental health care. However, equity barriers and diagnostic quality and patient safety outcomes are frequently reported. Telemedicine should be implemented within hybrid models supported by strong clinical governance and equity-by-design strategies. Health systems should integrate telemedicine within hybrid care models that align modality with clinical risk, patient preference, and digital access. Investments in broadband infrastructure, multilingual platforms, and digital literacy support are essential to reduce inequities. Standardized diagnostic safety metrics, clear escalation pathways, and structured assessment tools should be adopted to ensure safe virtual care. Future research must prioritize equity-sensitive reporting and robust safety evaluation.

Ethical Considerations

This was a systematic review of published literature and involved no direct participant contact or identifiable data; therefore, ethics approval and informed consent were not required.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contributions

Fath Elrahman Elrasheed and Awadalla Abdelwahid contributed equally to this work. Both authors conceived the study, designed the review protocol, supervised data extraction, and led the manuscript writing. Aalaa Almuazel, Hajar Suliman, Asim Abdelwahid Elnoor Ali, Abdelbagi Ali Elbashir Mohammed, Maha Murtada Abdelmageed, Maha Mohammed Bilal, Alla Abdelgader, Mona Abdelgader Ahmed Elasam, Abdalla Ali Abdalla, Ibrahim Daoud, Baharelden Abuobida, Dina Mahmoud

Fathi Mutwalli, Alaa Hussien Abdalmajed Jeaballa, Reem A. Younis, Mai Mamoun Yousif, Sarah Abdelaziz Abdelrahman Mohammed, Mohannad Mohamed, and Ghaida Hussien Abd Almajed Jeaballa contributed to screening, data extraction, quality appraisal, and interpretation of findings. All authors critically reviewed the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

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Data Availability

All data used in this review were extracted from publicly available published studies. No new datasets were generated. Additional materials, including extraction sheets and analytic summaries, are available from the corresponding author upon reasonable request.

Disclosure

The authors declare they have no conflicts of interest in the conduct, analysis, or publication of this research. No personal, financial, professional, or other ties to a client shaped and influenced the findings in this manuscript.

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